

Art. 34 Amelt.

# CLAIMS

1. A homogeneous liquid low molecular weight ethylene/alpha-olefin polymer having;
  - a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 25,000;
  - b) a total crystallinity, as measured by DSC, of less than 10%;
  - c) a pour point as measured by ASTM D97 of less than 50°C and
  - d) a melt viscosity at 150°C of less than 20, 000 cP.
2. The homogeneous liquid low molecular weight ethylene/alpha-olefin polymer of Claim 1, wherein said polymer is a copolymer of ethylene and at least one comonomer selected from the group consisting of ethylenically unsaturated monomers, conjugated or nonconjugated dienes, and polyenes, and has;
  - a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 15,000;
  - b) a comonomer incorporation of greater than 15 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 7%; and
  - d) a pour point as measured by ASTM D97 of less than 40°C.
3. The homogeneous liquid low molecular weight ethylene/alpha-olefin polymer of Claim 1, wherein said comonomer is an ethylenically unsaturated monomer selected from the group consisting of the C<sub>3</sub>-C<sub>20</sub> α-olefins, styrene, alkyl-substituted styrene, vinylbenzocyclobutane, 1,4-hexadiene, and naphthenics, and has;
  - a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 11,000;
  - b) a comonomer incorporation of greater than 30 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 5%; and
  - d) a pour point as measured by ASTM D97 of less than 25°C.

4. The homogeneous liquid low molecular weight ethylene/alpha-olefin polymer of Claim 1, wherein the comonomer is an ethylenically unsaturated monomer which is a C<sub>3</sub>-C<sub>20</sub> α-olefin, and wherein the α-olefin is further selected from the group consisting of 1-propene, isobutylene, 1-butene, 1-hexene, 1-heptene, 4-methyl-1-pentene, and 1-octene; and has:
  - a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 9,000;
  - b) a comonomer incorporation of greater than 40 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 2%; and
  - d) a pour point as measured by ASTM D97 of less than 15°C.
5. The homogeneous liquid low molecular weight ethylene/alpha-olefin polymers of Claim 4, wherein the comonomer is an ethylenically unsaturated monomer which is selected from the group consisting of propylene and 1-octene; and has:
  - a) a comonomer incorporation of greater than 50 mol percent; and
  - b) a pour point as measured by ASTM D97 of less than 0°C.
6. A process comprising reacting ethylene and at least one ethylenically unsaturated comonomer at a reaction temperature of at least 80°C in the absence of hydrogen and in the presence of a single site catalyst to form a homogeneous liquid low molecular weight ethylene/alpha-olefin polymer having:
  - a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 25,000;
  - b) a comonomer content of greater than 15 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 10%;
  - d) a pour point as measured by ASTM D97 of less than 50°C and
  - e) a melt viscosity at 150°C of less than 20,000 cP.
7. A pour-point reducing additive comprising a homogeneous liquid low molecular weight ethylene/alpha-olefin polymer having;

- a) a number average molecular weight ( $M_n$ ) as determined by gel permeation chromatography, of less than 25,000;
  - b) a total crystallinity, as measured by DSC, of less than 10%;
  - c) a pour point as measured by ASTM D97 of less than 50°C and
  - d) a melt viscosity at 150°C of less than 20,000 cP.
8. The pour-point reducing additive of Claim 7 wherein said homogeneous liquid low molecular weight ethylene/alpha-olefin polymer is a copolymer of ethylene and at least one comonomer selected from the group consisting of ethylenically unsaturated monomers, conjugated or nonconjugated dienes, and polyenes, and has;
- a) a number average molecular weight ( $M_n$ ) as determined by gel permeation chromatography, of less than 15,000;
  - b) a comonomer incorporation of greater than 15 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 7%; and
  - d) a pour point as measured by ASTM D97 of less than 40°C.
9. The pour-point reducing additive of Claim 7 wherein said homogeneous liquid low molecular weight ethylene/alpha-olefin polymer is a copolymer of an ethylenically unsaturated monomer selected from the group consisting of the  $C_3$ - $C_{20}$   $\alpha$ -olefins, styrene, alkyl-substituted styrene, vinylbenzocyclobutane, 1,4-hexadiene, and naphthenics, and has;
- a) a number average molecular weight ( $M_n$ ) as determined by gel permeation chromatography, of less than 11,000;
  - b) a comonomer incorporation of greater than 30 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 5%; and
  - d) a pour point as measured by ASTM D97 of less than 25°C.
10. The pour-point reducing additive of Claim 7 wherein said homogeneous liquid low molecular weight ethylene/alpha-olefin polymer is a copolymer of an ethylenically unsaturated monomer which is a  $C_3$ - $C_{20}$   $\alpha$ -olefin, and wherein the  $\alpha$ -olefin is further selected from the group consisting of 1-propene, isobutylene, 1-butene, 1-hexene, 1-heptene, 4-methyl-1-pentene, and 1-octene; and wherein said polymer has;

- a) a number average molecular weight ( $M_n$ ) as determined by gel permeation chromatography, of less than 9,000;
  - b) a comonomer incorporation of greater than 40 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 2%; and
  - d) a pour point as measured by ASTM D97 of less than 15°C.
11. The pour-point reducing additive of Claim 9 wherein said homogeneous liquid low molecular weight ethylene/alpha-olefin polymer is a copolymer of an ethylenically unsaturated monomer which is selected from the group consisting of propylene and 1-octene; and has;
- a) a comonomer incorporation of greater than 50 mol percent; and
  - b) a pour point as measured by ASTM D97 of less than 0°C.
12. A synthetic oil for use as a lubricant oil comprising the liquid low molecular weight ethylene/alpha-olefin polymer of Claim 1, said oil having a kinematic viscosity at 100°C of 4 to 200 centistokes.
13. A homogeneous gel-like low molecular weight ethylene/alpha-olefin polymer having;
- a) a number average molecular weight ( $M_n$ ) as determined by gel permeation chromatography, of less than 25,000;
  - b) a total crystallinity, as measured by DSC, of less than 50%;
  - c) a pour point as measured by ASTM D97 of less than 90°C and
  - d) a melt viscosity at 150°C of less than 20,000 cP.
14. The homogeneous gel-like low molecular weight ethylene/alpha-olefin polymer of Claim 13, wherein said polymer is a copolymer of ethylene and at least one comonomer selected from the group consisting of ethylenically unsaturated monomers, conjugated or nonconjugated dienes, and polyenes, and has;
- a) a number average molecular weight ( $M_n$ ) as determined by gel permeation chromatography, of less than 15,000;
  - b) a comonomer incorporation of greater than 10 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 40%; and
  - d) a pour point as measured by ASTM D97 of less than 80°C.

15. The homogeneous gel-like low molecular weight ethylene/alpha-olefin polymer of Claim 13, wherein said comonomer is an ethylenically unsaturated monomer selected from the group consisting of the C<sub>3</sub>-C<sub>20</sub> α-olefins, styrene, alkyl-substituted styrene, vinylbenzocyclobutane, 1,4-hexadiene, and naphthenics, and has;

- a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 11,000;
- b) a comonomer incorporation of greater than 12 mol percent;
- c) a total crystallinity, as measured by DSC, of less than 30%; and
- d) a pour point as measured by ASTM D97 of less than 70°C.

16. The homogeneous gel-like low molecular weight ethylene/alpha-olefin polymer of Claim 13, wherein the comonomer is an ethylenically unsaturated monomer which is a C<sub>3</sub>-C<sub>20</sub> α-olefin, and wherein the α-olefin is further selected from the group consisting of 1-propene, isobutylene, 1-butene, 1-hexene, 1-heptene, 4-methyl-1-pentene, and 1-octene; and has;

- a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 9,000;
- b) a comonomer incorporation of greater than 13 mol percent;
- c) a total crystallinity, as measured by DSC, of less than 20%; and
- d) a pour point as measured by ASTM D97 of less than 60°C.

17. The homogeneous gel-like low molecular weight ethylene/alpha-olefin polymers of Claim 16, wherein the comonomer is an ethylenically unsaturated monomer which is selected from the group consisting of propylene and 1-octene; and has;

- a) a comonomer incorporation of greater than 15 mol percent; and
- b) a pour point as measured by ASTM D97 of less than 40°C.

18. A process comprising reacting ethylene and at least one ethylenically unsaturated comonomer at a reaction temperature of at least 80°C in the absence of hydrogen and in the presence of a single site catalyst to form a homogeneous gel-like low molecular weight ethylene/alpha-olefin polymer having;
- a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 25,000;
  - b) a comonomer content of greater than 10 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 50%; and
  - d) a pour point as measured by ASTM D97 of less than 90°C and
  - e) a melt viscosity at 150°C of less than 20,000 cP.
19. A pour-point reducing additive comprising a homogeneous gel-like low molecular weight ethylene/alpha-olefin polymer having;
- a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 25,000;
  - b) a total crystallinity, as measured by DSC, of less than 50%;
  - c) a pour point as measured by ASTM D97 of less than 90°C and
  - d) a melt viscosity at 150°C of less than 20,000 cP.
20. The pour-point reducing additive of Claim 19 wherein said homogeneous gel-like low molecular weight ethylene/alpha-olefin polymer is a copolymer of ethylene and at least one comonomer selected from the group consisting of ethylenically unsaturated monomers, conjugated or nonconjugated dienes, and polyenes, and has;
- a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 15,000;
  - b) a comonomer incorporation of greater than 10 mol percent;
  - c) a total crystallinity, as measured by DSC, of less than 40%; and
  - d) a pour point as measured by ASTM D97 of less than 80°C.
21. The pour-point reducing additive of Claim 19 wherein said homogeneous gel-like low molecular weight ethylene/alpha-olefin polymer is a copolymer of ethylene and a comonomer wherein said comonomer is an ethylenically unsaturated monomer

selected from the group consisting of the C<sub>3</sub>-C<sub>20</sub>  $\alpha$ -olefins, styrene, alkyl-substituted styrene, vinylbenzocyclobutane, 1,4-hexadiene, and naphthenics, and has;

- a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 11,000;
- b) a comonomer incorporation of greater than 12 mol percent;
- c) a total crystallinity, as measured by DSC, of less than 30%; and
- d) a pour point as measured by ASTM D97 of less than 70°C.

22. The pour-point reducing additive of Claim 19 wherein said homogeneous gel-like low molecular weight ethylene/ $\alpha$ -olefin polymer is a copolymer of an ethylenically unsaturated monomer which is a C<sub>3</sub>-C<sub>20</sub>  $\alpha$ -olefin, and wherein the  $\alpha$ -olefin is further selected from the group consisting of 1-propene, isobutylene, 1-butene, 1-hexene, 1-heptene, 4-methyl-1-pentene, and 1-octene; and wherein said polymer has;

- a) a number average molecular weight (Mn) as determined by gel permeation chromatography, of less than 9,000;
- b) a comonomer incorporation of greater than 13 mol percent;
- c) a total crystallinity, as measured by DSC, of less than 20%; and
- d) a pour point as measured by ASTM D97 of less than 60°C.

23. The pour-point reducing additive of Claim 22 wherein said homogeneous gel-like low molecular weight ethylene/ $\alpha$ -olefin polymer is a copolymer of an ethylenically unsaturated monomer which is selected from the group consisting of propylene and 1-octene; and has;

- a) a comonomer incorporation of greater than 15 mol percent; and
- b) a pour point as measured by ASTM D97 of less than 40°C.

24. A synthetic oil for use as a lubricant oil comprising the gel-like low molecular weight ethylene/ $\alpha$ -olefin polymer of Claim 13, said oil having a kinematic viscosity at 100°C of 4 to 200 centistokes.

25. The homogeneous liquid low molecular weight ethylene/ $\alpha$ -olefin polymer of Claim 1, wherein the melt viscosity at 150°C is less than 10,000 cP.